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small bustards. In the mountains, bears, several sorts of deer, the ibex, and wild goat. The sport therefore is very good and varied, as the above will show. I went out three times with the Consul, Mr. Holmes, and saw enough to convince me that those who are fond of sport will find plenty of it in this neighbourhood.

The great curse of all these Oriental towns is the filth of the streets. This disgusting feature demonstrates the apathy and indifference of the authorities to the sanitary condition of the town. In some places within the walls the stench arising from deposits of filth is abominable. A traveller would imagine that cleanliness did not form part of the Mohammedan creed, whereas particular stress is laid upon the injunctions with regard to observance of purity and decorum.

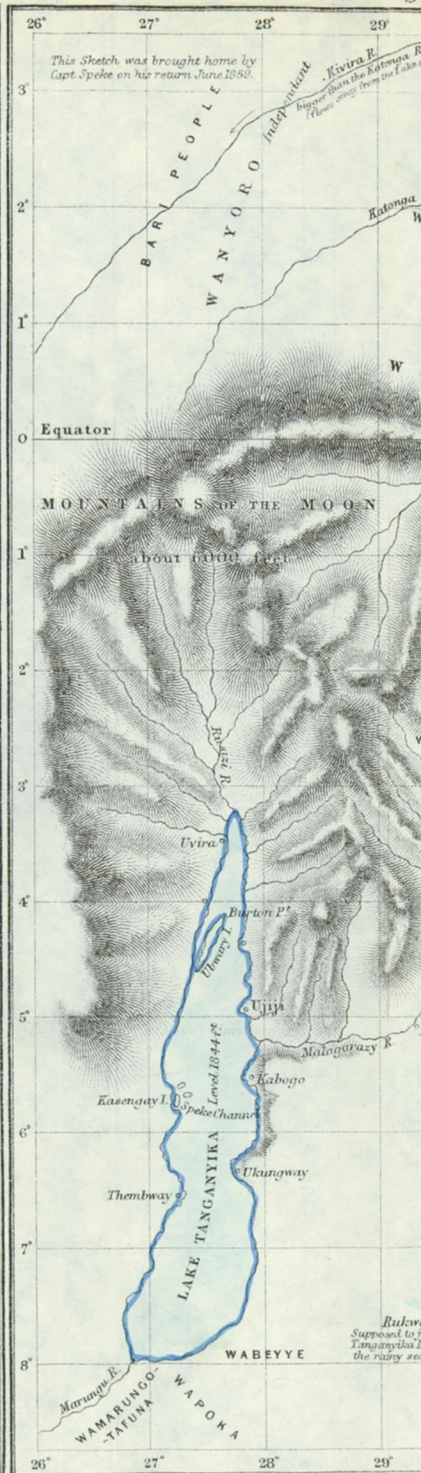
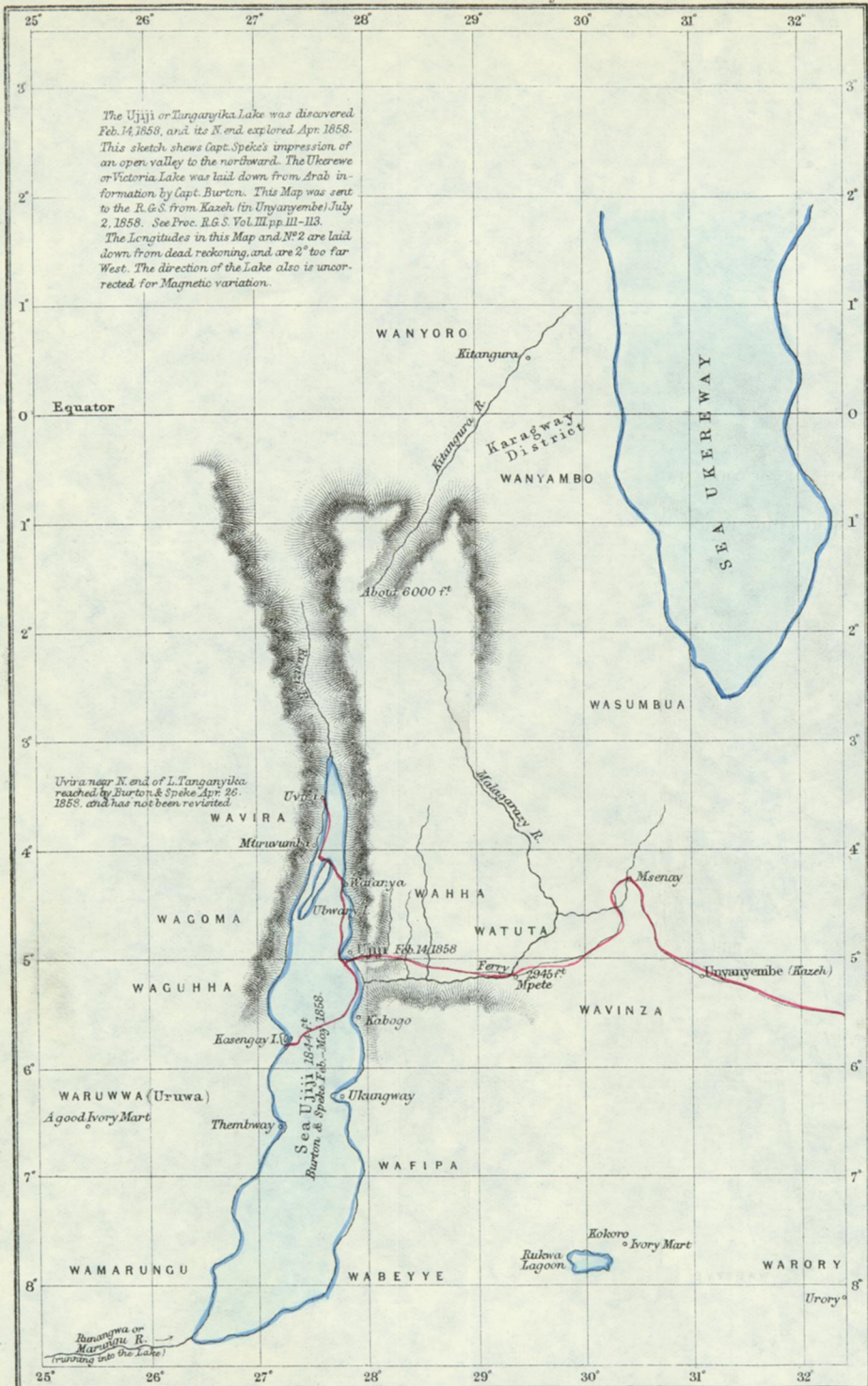
X. — *On Dr. Livingstone's last Journey, and the probable Ultimate Sources of the Nile.* By ALEX. GEO. FINDLAY, F.R.G.S.

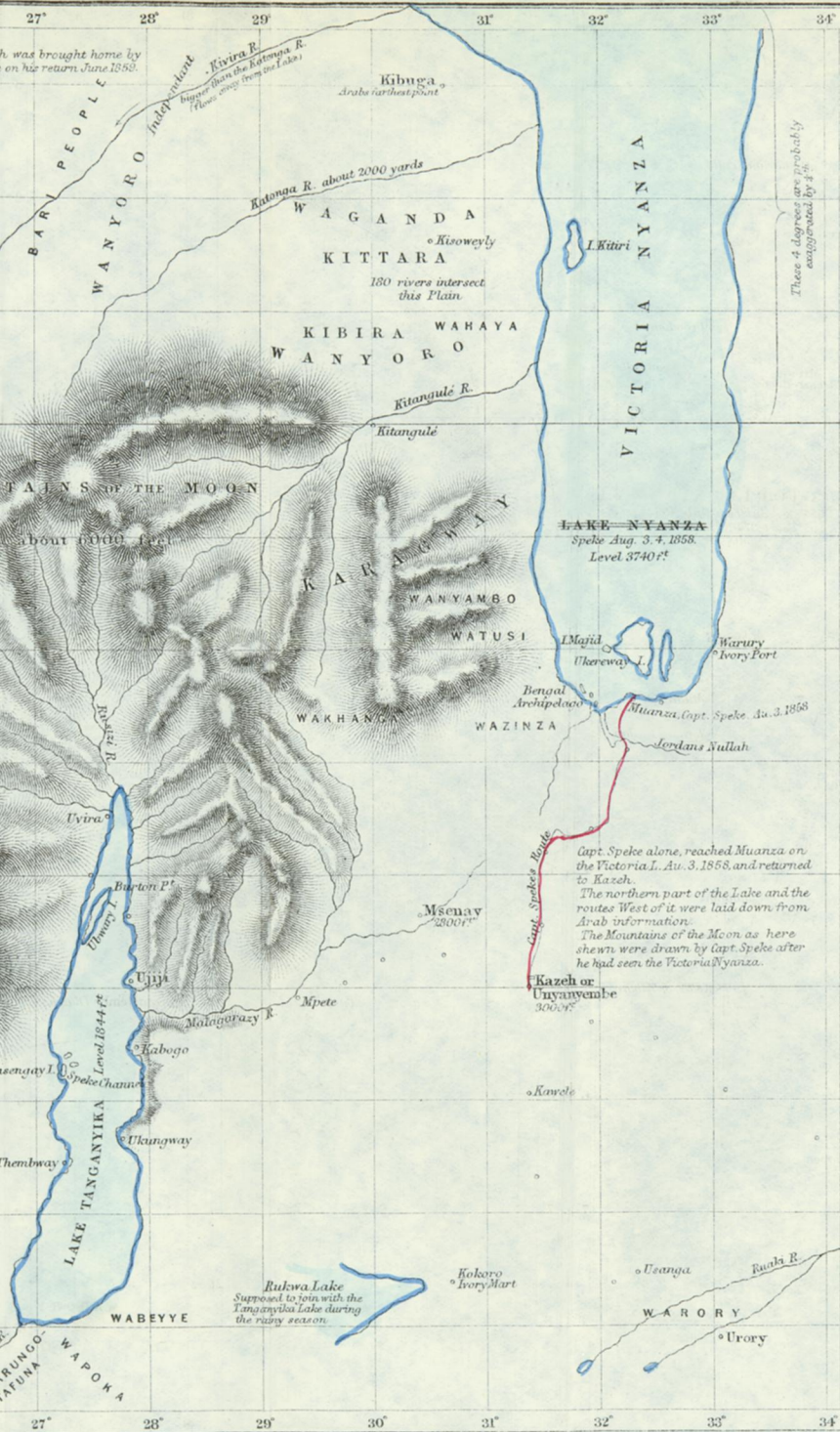
Read, June 3, 1867.

THE object of these remarks will be to demonstrate, as far as it is possible to do so inferentially, that Dr. Livingstone has reached, or was about to enter, the southern limits of the basin of the Nile when the last painful news of him was forwarded from Africa.

I wish to premise that this conclusion is the result of a long-standing conviction that Lake Tanganyika would some day prove to be the southern reservoir of the Nile. I arrived at this when I was very much engaged with Captains Burton and Speke, in 1859, in discussing and calculating the very copious and most excellent data brought home by their nobly completed expedition of 1856-9. This first East African expedition has had scant justice done to it of late, seeing that it was the first harvest, and that by much the most abundant one, of those brilliant discoveries in Eastern Africa so eminently fostered by the Royal Geographical Society.

No apology is needed for introducing this topic at the present moment, or for considering the last journey of Dr. Livingstone, our noble explorer, to whom so many of us are united by the ties of friendship. The *first* despatch from the interior, which we had been anxiously awaiting, would, I believed, have definitively settled the question I am about to propose.









The points I wish to insist on are these :—

1. That Dr. Livingstone has determined that the Tanganyika Lake has no connexion with the Nyassa Lake :
2. That all known testimony makes the river run *into* the south end of the Tanganyika Lake :
3. That it *must* have an outlet, and that is probably to the north.
4. That the observations of Sir Samuel Baker, as compared with those of Captain Speke, make the Albert Nyanza on the same level with the Tanganyika Lake ; and further, that the two lakes join each other :
5. Therefore, the streams which flow north-westward from the mountains at the head of the Nyassa Lake contain the true sources of the Nile.

The following notes will refer exclusively to the physical geography of the region ; and in the first place I would advance, as an axiom, that the accounts given by older authors should be judged by the light of recent and positive knowledge, and not be arranged according to the imperfect reports of incompetent travellers, or the vague ideas gained from native report.

Captain R. F. Burton, who should claim the discovery of the Tanganyika Lake, has argued against his first decision, and gives many reasons now for making the lake flow to the northward (see 'Journal Royal Geographical Society,' vol. xxxv., 1865, pp. 1-15). What follows will be supplementary to that, and based chiefly on facts more recently acquired.

I trust that the subject will be made intelligible to the reader by the aid of the diagrams appended to this, which are placed in juxtaposition, and show the different views which have been formed.

To commence with the southernmost portion of our subject. Lake Nyassa, as is well known, was first seen by Dr. Livingstone September 16th, 1859.* He had followed up the important River Shiré to its outlet from the lake. It was afterwards visited by the unfortunate Dr. Roscher, who reached it from Kilwa on November 19th,† two months after Dr. Livingstone had visited it. Dr. Roscher was murdered a short distance from the east shore of the lake in about lat. 12° 40' s.

The lake is very deep, possibly much exceeding 116 fathoms, and has the deep blue or indigo tint of the Indian Ocean—a

* Dr. Livingstone, 'The Zambesi and its Tributaries,' p. 123.

† Despatch from Lieutenant-Colonel Rigby, July 15, 1866.

sufficient proof of its great depth.* The eastern shore has not been seen, but it is known to be limited on that side by lofty mountains. On the west the beautiful tree-covered heights, probably 4000 to 5000 feet high, are the edges of table-lands, through which flow five rivers, the only affluents on this side. These, with what others enter it from the east and north, will be sufficient to account for the annual rise of the lake (about 3 feet) in January and for the flow of the Shiré.

The northern end of the lake is of the greatest interest in relation to the question now under consideration. It was visited, as is well known, by Dr. Livingstone's expedition a second time in October, 1861. Dr. Livingstone and his party landed near its north-east extreme in lat. $11^{\circ} 32'$, leaving Dr. Kirk and Charles Livingstone in their boat.† The land party struck inland on approaching the foot of the mountains, which rise abruptly from the lake. They encountered a body of the dreaded Mazitu, the effects of whose terrible warfare on the natives had been before observed. The boat party got separated from them for four days, and reached about lat. $11^{\circ} 20' \text{ s.}$, and saw about 20 miles still further north, or to about lat. 11° s.

The published narrative, and still more the conversations, of Dr. Livingstone and Dr. Kirk lead to the incontrovertible conclusion that no river of considerable magnitude ENTERS the north end of the Nyassa Lake. From the height of at least 1000 feet, over which the land party toiled, the dark mountain masses on both sides of the lake were seen closing in. At this elevation the view extended at least as far as that from the boats; and it was believed the end of the lake lies on the southern borders of 10° , or the northern limits of $11^{\circ} \text{ s. lat.}$ Native testimony, also, whatever weight that may have, confirms this view.

"Mankambira (the chief of the place where Dr. Livingstone landed, within 45 miles of the presumed head of the lake) had never heard of any large river in the north, and even denied its existence altogether; giving us, at the same time, the names of the different halting-places round the head of the lake and the number of days required to reach the coast opposite his village, which corresponded, as nearly as we could judge, with the distance at which we have placed its end."‡

All other native testimony, too, tends in the same direction. Every native questioned by Drs. Livingstone and Kirk assured them that no large stream entered the lake, but that two small rivers alone enter the lake from the north. Dr. Kirk says that

* 'The Zambesi and its Tributaries,' pp. 369-371.

† Ibid., p. 381.

‡ Ibid., p. 390.

one of them was named Rovu, meaning "river," and the other a small river coming in from a marsh.*

The settlement of this point in the physical geography of East Africa carries with it the conclusion as to the water-parting of the whole of the river systems between the Zambezi and the Nile. For, should any river fall into the north end of Lake Nyassa, it must be a very large one: draining, as it must do, an area of at least 300,000 square British miles, or a country as large as England and France combined.

Dr. Livingstone's first journeys to the Nyassa Lake, therefore, did all but conclusively determine that Lake Tanganyika has no outlet to the southward.

It has been frequently argued, and especially by Captain Speke, that the Tanganyika Lake drained into the Nyassa. Their relative levels, as far as is known, would admit of such a theory. Dr. Kirk's careful and satisfactory observations, in August to October, 1860, make Lake Nyassa to be 1522 feet above the sea: a much lower elevation than that previously assigned to it, and *at least* 300 feet, and possibly 1300 feet, below Tanganyika Lake.†

Now, as Dr. Livingstone's journey had, for one of its primary objects, the determination of this important point, it may be inferred that his last journey confirmed his previous convictions. We know that he had crossed a marsh, which was found to stretch farther north than he had previously seen, and then continued his journey *westward*. If this marsh had been traversed by the course of a large river, such as the requirements of the case lead to the certain inference, he would have followed up this important feeder to the *northward*, and traced its connexion, if any, with the northern lake, or till its character was really determined.‡

Therefore, I hold it to be a point now settled beyond controversy, that Dr. Livingstone has determined that Lake Nyassa and Lake Tanganyika have no connexion with each other; and by that decision has also determined, in a great measure, where we are to look for the true sources of that still mysterious Nile; for it will be shown that there are all but insuperable diffi-

* See Dr. Kirk in 'Proceedings,' 1864, vol. vii. p. 261.

† See 'Journal,' 1865, vol. xxxv. pp. 168, 169.

‡ The expedition commanded by Mr. Young determined that Dr. Livingstone passed round the *south* end of Lake Nyassa, instead of to the north of it, as was supposed by Dr. Kirk, and as was fully expected he would do, in order to settle, finally, this important point. This does not affect the problem here proposed. Dr. Livingstone either obtained further knowledge of the north end of the lake on his last journey, or he was so fully convinced, on his previous explorations, that it had no connexion with Tanganyika Lake, that he considered the point as beyond question.

culties in accounting for the drainage of Lake Tanganyika to the Atlantic, through the Congo, on the one hand, or to the Indian Ocean, by the Rufiji or other river, on the other.

Besides this satisfactory evidence of the non-connexion of the Tanganyika with the Nyassa Lake, there is another, quoted by Captain Burton, which may here be repeated. Dr. Kirk says, "Among the few natural specimens preserved by Captain Burton was a small collection of shells from Tanganyika. Dr. Kirk brought some from Nyassa. Between them there is *no community of species*, while both contain many new forms. Among those from Nyassa is one of a type for the first time observed in Africa, and, being large and handsome, it could not easily have been overlooked were it present in Tanganyika. On the other hand, Captain Burton's collection possesses one species common on the Nile, and unknown on the Nyassa."* In the paucity of our knowledge of the lake regions every fact is important towards forming a conclusion, and this one must be added to the other evidence of the non-connexion of the two lakes.

We assume, then, that if it is argued we have no *direct* evidence that this fact is positively determined, that every weight of argument is in favour of such a conclusion.

The SECOND point in our subject is the direction of the streams running south of the Tanganyika Lake.

The distance from the north end of Lake Nyassa to the reported southern part of Lake Tanganyika is about 340 or 350 miles, and the direction is N. 55° W. Of the country immediately intervening we know nothing but from very imperfect native report. About the mountainous country further west we have more information, several important routes having traversed it.

First, from Dr. Livingstone. After having explored the western shore of Lake Nyassa, he started from about its centre in September, 1863, for the west, a period of the year too late to accomplish any great exploration. But he succeeded in determining one very important point—the position of the water-parting of the rivers flowing into Nyassa, and those flowing westward. At his farthest point at Chinangas, in lat. 12° 46' S., and at 85 miles in direct distance from the lake, he reached the summit of the dividing range; granitic masses lay around it, and in the north appeared a heap of blue mountains.† The elevation is not mentioned, but it must have been considerable, for the piercing winds had an extraordinary effect on his followers, one of whom died from the effect of the air.

* See 'Journal,' vol. xxxv. pp. 2, 3.

† 'The Zambesi and its Tributaries,' pp. 516, 538.

In their progress westward they heard a good deal from the travelled Babisa and Arabs, who knew the country well, of a small lake called *Bemba*.

“As we proceeded west, we passed over the sources not only of the Loangwa (of the Maravi flowing into the Zambesi) but of another stream called Moitawa or Moitala, which was represented to be the main feeder of Lake Bemba. This would be of little importance, but for the fact that the considerable river Luapula, or Loapula, is said to flow out of Bemba to the westward, and then to spread out into another and much larger lake, named Moero or Moelo. Flowing still farther, the Loapula forms Lake Mofue, or Mofu; and after this it is said to pass the town of Cazembe, bend to the north, and enter Lake Tanganyika.”

It is very much to be regretted that this important point was not further examined. The approach of the rainy season and the recall of the expedition caused it to be abandoned, and a hasty return to the Lake Nyassa, and thence to Europe, has closed this interesting topic for the present.

Beyond the point attained by Dr. Livingstone no recent traveller has penetrated; but further to the westward several expeditions have passed from the Portuguese settlements on the Zambesi to within a very few miles of the probable southern end of the Tanganyika Lake. The chief of these are cited, not as novelties, for they have been often quoted, but because the present moment invests them with a stronger interest.

A Portuguese colonist from Goa, Gonçalo Gaetano Pereira,* had sent from Tette more than one trading mission to the Cazembe prior to 1786, and in that year sent his son, Manoel Pereira, in charge of a mission to the same potentate. The accounts given by these enterprising men, as related by Dr. de Lacerda in his preliminary notes to the account of his expedition, contain many geographical features of importance to our present subject.

Manoel Caetano Pereira, the son, started in May, 1786, with his own slaves and the Muizas who had brought down the Cazembe's ivory the year before; and after traversing the land of the Maravi—a term by which the great lake (Nyassa) was then known to geographers—was forty-five days in reaching the Aroangua River, the stream whose head-waters were found by Dr. Livingstone in September, 1863, and then called the Loangwa or Zumbo, the latter name from the place where it falls into the Zambesi 220 miles above Tette. In twenty days more he struck another river, called Zambeze, of which Dr.

* Related in the introduction to Dr. de Lacerda's Narrative, published in the 'Annaes Maritimos,' Lisbon, 1841, &c. I have availed myself of a MS. translation, by Captain Burton, of this important work, now invested with a peculiar interest.

Lacerda says, "From the information of the people I venture to say that it is not our Zambeze, or any of its influents from the Xire (Shiré) river upwards. The Zambeze of the Muizas flows to the *right* hand of those crossing it from Tete, and falls into other streams;" but he makes some confusion afterwards in the lakes into which it runs. "Manoel's party travelled thirty days from the river to the King's capital, crossed some deserts, and spent a day fording a lake waist deep. This body of water is drained by *two* channels, one to the Zambeze, the other to the Murusura River, which passes the royal residence." What follows is almost unintelligible, at least with our present knowledge, but it is directly confirmatory of what Dr. Livingstone has heard so recently.

In the further expedition to the father of the Cazembe chief, Muata-Ya-Novo, to the north-west, the route appears to cross some of the affluents of the Luapula River, which it could be demonstrated, as far as our imperfect knowledge goes, flows to the north-east and east.

By much the most important geographical exploration of this country, next to that of Dr. Livingstone, was that made by order of the Portuguese Government in 1798-9, under Dr. F. J. M. de Lacerda e Almeida, who was no ordinary man. He was a Brazilian by birth, but graduated at Coimbra, where he became a Doctor of Mathematics. He was appointed astronomer to the King of Portugal, and left Lisbon in January, 1780, to lay down the frontier line of the great South American colony. He returned to Lisbon in 1790, and afterwards went to Africa, by royal command, on a mission to the Cazembe.

The important mission of Dr. de Lacerda left Tette for the country of the Cazembe on July 3, 1798. The object of this costly and noble undertaking was, as he tells us, to ascertain if Central Africa contains any mountain capable of sending forth the Cuñene River, which falls into the Atlantic a little below Cabo Negro, and to find a short and easy communication overland from Portugal to the Rios de Sena, and especially to seek the means of bringing these infidels into the bosom of the Church. In the instructions which he issued to his officers, to be followed in case of his own death, he makes especial mention of the "Zambeze," reported by the Pereiras; and directs that if it should flow to the right (that is, *eastward*) they would do well to descend it to ascertain whether it falls into the Shiré, but if to the left or westward, it may be the Cuñene, a river which Dr. de Lacerda had endeavoured, unsuccessfully, to explore in 1798, and then it is to be followed down to its mouth, and thence find their way to Benguella. The same method of

proceeding is laid down with respect to the river flowing past the Cazembe's capital.

Dr. de Lacerda e Almeida was most liberally and honourably treated by the Court of Portugal. He was made governor of the Rios de Sena, in the captaincy of Mozambique, and had a retinue far too large for such an expedition. The second in command was a chaplain, and with him were five other civilians and five military subordinates, five other officers, and fifty men-at-arms as an escort. This large and unmanageable party, with the crowd of negroes and negresses as porters, caused the greatest annoyance to the two leaders, and finally thwarted the chief object of the mission, that of crossing Africa from east to west.

The expedition started, as before stated, on July 3, 1798, and reached the northern Aruangoa River at the end of August; on the 30th they reached the Serra Muchingua, which he named Antonina, in honour of the Prince, fixing astronomically a point about 70 miles south-eastward of it, Mazavamba, in lat. $12^{\circ} 33'$, long. $32^{\circ} 18' 15''$. This very important position gives us a perfect clue to the course taken by the expedition, and the approximate position of the important Muchingua or Mxinga Range, probably a continuation of that seen by Dr. Livingstone north-west from Lake Nyassa, and which also may be the dividing range of the waters which flow towards the Zambeze on the south and those which pass through the Cazembe's country to the northward. Dr. de Lacerda afterwards speaks of the desolate and rugged country they traversed and the cold they suffered from, which indicates a lofty region.

On September 10th they reached the northern Zambeze River, and here they made some geographical difficulty. I quote Dr. de Lacerda:—

“My principal desire being to obtain exact geographical notes of the size and the direction of all streams crossed between Tete and the Cazembe's country, and from the latter to Angola, I laboured to extract information from different Muize Caffres, and from Manoel Caetano Pereira, making repeated and compared inquiries to avoid errors arising from strange languages. All uniformly and repeatedly assured me that the Zambeze (Chambeze) and the Ruçurue River ran to the RIGHT of one travelling to the Cazembe. Pereira confirmed this information, from which I infer that he does not know his right from his left hand.”

Again :

“To-day (Sept. 11, 1798) I sent to inquire about the course of the Zambeze of sundry Mussucumos, a tribe mixed with the Muizas, some vassals of Cazembe (these were my informants) and others independent: *all* said that it trends to the river which runs by the city of the Cazembe,—whatever be the worth of their information, which at present I neither allow nor disallow.”

Now nothing can be more circumstantial or direct than this

information, that the rivers (which Gamitto says first flow to the west) ultimately join that running northward past the Cazembe's city—the Luapula or Guapula River.

When this is connected with what is related by Dr. Livingstone, of the streams flowing westward from what is probably the westernmost spur of the great Moxing Mountains, and which is further confirmed by the undeviating testimony obtained further north, it seems that it would be a perfectly fair inference to state that Dr. Livingstone had seen and crossed the head-waters of one or other of the streams which flow toward the Cazembe country.

The position of the crossing of this northern Zambeze by Dr. de Lacerda is well ascertained, for on September 21st, 1798, eleven days afterwards, he observed an immersion of Jupiter's first satellite, which gave him the longitude of $30^{\circ} 1' 45''$ E., this was in lat. $10^{\circ} 20' 35''$, and was his last astronomical observation. The place he calls Mouro Achinto, which Gamitto says was the name of the village chief. When Monteiro was here October 15, 1831, it was called by the name Messire Chirumba.*

Dr. de Lacerda's further journey to the Cazembe's capital is a narrative of his personal sufferings. He passed near to a great lake on his left hand (westward), which has been called Chama; but this was the name of the district (it is also called the Shuia Lake), and reached Lucenda October 3, 1798, worn out with fever and anxiety. Thus died this most excellent man and accomplished traveller. Had his life been spared, we should most probably have had a much more perfect knowledge of the physical geography of this important region. His followers returned to Tette under the guidance of the chaplain.

The next travellers in this region who give any clear account of the country are Major José Manoel Correa Monteiro, as related by his companion Major A. C. P. Gamitto, who went on a mission to the capital of the Cazembe—Lunda or Lucenda, in 1831-2.† Major Gamitto's itinerary is little more than a recital of the rivers and hills they crossed; but few other geographical details are found. This undertaking was set on foot from a similar cause to that of Dr. Lacerda. Towards the close of 1830 a cafila of Cazembes arrived at Tette with ivory for sale.‡ This led the governor of Sena to appoint the above-named officers on

* 'O Muata Cazembe,' p. 196.

† 'O Muata Cazembe, e os povos, &c., da Africa Austral; Diario da Expedição Portuguesa commandada pelo Major Monteiro, e redigido pelo Major A. C. P. Gamitto. Lisboa, 1854.'

‡ 'O Muata Cazembe,' p. xviii.

this embassy. They started June 1, 1831, and followed the same general line of march described by Dr. de Lacerda.

On September 19th they crossed the Serra Muxinga,* called by Dr. de Lacerda Muchingua, and named by him the Cordelheira Antonina. No estimate is given of its height; but it must be exceedingly lofty, for on the second day of their ascent they marched a league, continually ascending to the ridge of the mountain, where the pass was obstructed by an immense rock, like a portal to the defile. The direct route lay through a natural aperture, $2\frac{1}{2}$ feet in diameter, in this rock, or else around it, over a terrible and dangerous precipice. This passed, they came upon a difficult and elevated desert country, where they suffered much from hunger.

On their return they reached the Serra Muxinga on August 10, 1832, and give a longer account of it. It stands as it were alone, rising at once abruptly and very steeply from the tableland, but traverses an immense extent of country. It was estimated to reach an elevation above the sea of a league (Portuguese, or about 19,700 feet). Its head was nearly always enveloped in clouds, but no sign of snow or ice was visible or reported. The height, probably, is exaggerated, but Gamitto says that it is by much the most lofty summit in this part of Africa, and has precipices of a prodigious height. It commands most extensive prospects to the northward.†

On October 9th they reached the River Chambezi, called by the natives Cono, a very rapid stream running to the west, but where afterwards no one knew; but Monteiro thought it might reach the Zambeze.‡ There is nothing, then, in their diary that militates against the results of the much more useful inquiries made by Dr. de Lacerda.

Without following our travellers further, or further alluding to the great lakes they passed, or that of Mofo near to the Cazembe capital, it may be accepted as a general conclusion, from their evidence, that the streams from the north-west of the Lake Nyassa, and northward of the mountainous desert which skirts the Serra Muxinga, run towards the lakes at the Lunda capital, and then, as far as report says, to the north-eastward.§

To these testimonies we must add the more important one of Dr. Livingstone. As before quoted, he had taken great pains to ascertain from the travelled Babisa and Arabs as much as possible about the country in front.

* 'O Muata Cazembe,' pp. 170-172.

† Ibid., p. 402.

‡ Ibid., p. 447.

§ See 'Proceedings,' 1864, vol. vi. p. 262. Dr. Kirk confirms this—that the Loapula flows north into a small lake.

“There could be no doubt that our informants had been in the country beyond the Cazembe’s. The Lualaba is said to flow into the Luapula; and when, for the sake of testing the accuracy of the traveller, it was asserted that all the water of the region round the town of the Cazembe flowed into the Luambadzi, or Luambezi (Zambesi), they remarked, with a smile, ‘He says the Loapula flows into the Zambezi—did you ever hear such nonsense?’ or words to that effect. Their geographical opinions are now only stated without any further comment than that the itinerary given by the Arabs and others shows that the Luapula is twice crossed on the way to the Cazembe’s; and we may add that we have never found any difficulty from the alleged incapacity of the negro to tell which way a river flows.”*

Although it is a great trading highway with the Arabs and natives, no European traveller has passed north-eastward of the Cazembe’s city.

To carry the argument that the waters flow north-eastward farther, we derive some information from another region, that of Lake Tanganyika.

All recorded testimony acquired from the natives prior to the first East Africa expedition, and information given to Captain Burton, and every pains taken both by that traveller and Captain Speke, while in the country, only lead to one conclusion—that at the south end of Tanganyika Lake a river, the Runangwa or Marungu, runs *into* it; and it is only of late that any theory has made it run out, and so join the Nyassa Lake. There is nothing more certain known now of any particular of the great Tanganyika Lake than was acquired in the first and only visit made to it in February to May, 1858; and as the geographical relation of this great and important body of water to African hydrology rests upon a single and very questionable observation, a few brief, though well known, particulars are here cited.

The first East Africa expedition, sent out by the Royal Geographical Society in October, 1856, was organised and arranged by Captain Burton. He was joined by Captain Speke at Cairo, November, 1856, and finally left Zanzibar for the interior in June, 1857. This fine undertaking was most inadequately subsidized. Only 1000*l.* was supplied by the Government, through the Society, 750*l.* at the outset, and 250*l.* on their return. The rest of the total cost, 2500*l.*, was defrayed jointly by the travellers themselves.

It succeeded beyond expectation, and I think that I am warranted in stating that there never was an expedition based on such limited means, traversing an entirely unknown country, through miseries and difficulties only then first ascertained, which brought to the knowledge of civilized man such a harvest of information on almost every branch of interest. The topography of Captain Speke is wonderfully perfect, considering his

* ‘The Zambesi and its Tributaries,’ pp. 532, 533.

health and means of observation; and the 29th volume of the Society's Journal contains a masterpiece of descriptive geography.

Delayed, tormented, deserted, and robbed by their escort and party, with health broken by the deadly bilious remittents of the coast region, the travellers struggled on over the high table-land (2500 to 3500 feet) between the coast ranges of the Rufuta and Rubeho Mountains, and reached the settlement of Muskat Arabs at Kazeh in Unyanyembe, where they received a warm welcome. This was on November 7th, 1857, and at the elevation of about 3500 feet. Their well kept journals and observations on this part of the route are perfectly satisfactory.

About this time, I believe, for the record is lost, they broke their trustworthy hypsometrical apparatus, and subsequently had to depend on much less perfect instruments.

They were too long delayed here by sore illness, and before they could start the great rains had set in. Under these most adverse conditions did these brave men struggle on down the pestiferous course of the Malagarazi River. Captain Speke was so affected by the climate and season that he became almost blind, and Captain Burton became partially paralyzed in the extremities, so that he had to be carried in a hammock to the great lake. They reached Ujiji, on the shore of the Tanganyika Lake, then seen for the first time, on February 18th, 1858. A single observation of Captain Speke, with what he described to me as a "bath" thermometer, gave as the elevation of the lake 1844 feet. But this thermometer read 214° instead of 212° , when brought down to the east coast again. Captain Speke's second expedition will perhaps indicate when the index error, which subsequently increased to this great extent, became sensible. There was only one lunar observation taken for the longitude of Ujiji, which point determines the position of the lake, and this was discarded, and the position laid down from dead reckoning; but I believe that it cannot be far wrong. How energetically the intrepid travellers essayed, without success, to reach the north end of the lake, and thus solve the great secret, has been often told.

They had, however, seen what appeared to be the end of the lake, in lat. $3^{\circ} 8' \text{ s.}$, and the impressions then received were placed on the map No. 1 by Captain Speke.

The general character of Tanganyika Lake, as ascertained by observations and by hearsay, was as follows:—From Ujiji to the north end, as far as was seen, was about 100 geographic miles. Captain Burton estimated, from report, that it was 150 miles from Ujiji to the south end, making it 250 miles in length. Captain Speke's maps extend this considerably. His first

map makes its south end 230 miles from Ujiji, terminating in lat. $8^{\circ} 30'$ s. His second map abridges this to lat. $8^{\circ} 6'$. His first published map reduces it to lat. $7^{\circ} 45'$, like Captain Burton's estimate. This would be within 80 or 100 miles of Lucenda, the Cazembe capital.

It is evidently very deep, but no soundings could be taken. No mention is made, or evidence seen, of any change of level.

The general formation suggests the idea of a volcano of depression, not like the Victoria Nyanza or Ukerewe, a vast reservoir, formed by the drainage of mountains. Judging from the eye, the walls of this basin rise in an almost continuous curtain, rarely waving and inflected, to 2000 or 3000 feet above the water-level. The water appears deliciously sweet and pure. The people, however, who drink it willingly, prefer the water from the little springs on its shores, and also that from Nyanza. It appears to corrode metal and leather.*

The principal rivers were the Malagarazi, which rises in Usinza, and, after a course of about 250 or 260 miles, falls into the eastern side of the lake, 16 miles below Ujiji. The Marungu, or Runangwa, of which mention has been made, and which is about equal in volume to the Malagarazi, enters it from the w.s.w. or south-west at its southernmost extremity, and is almost certainly the same river as the Luapula, which passes north-east of the Cazembe capital.

The third river, which is said to be larger than the Marungu and Malagarazi united, is the Rusizi, at its north end. Until Burton and Speke visited Uvira at its north end, April 26, 1856, all testimony unvaryingly stated that it ran OUT of the lake. Then, and only on this occasion, did they hear, from the sons of the local chief, Marulas, that it ran INTO the lake.† Their lawless crew of unruly Wajiji savages would not allow them to go to it, and thus has the most important question remained a matter for dispute and discussion till the present day.

Upon this information, and upon the supposed depression of the lake below the lands to the northward, Captain Burton argued that it was a still lake, one without an inlet.

In the many conversations I had with Captain Speke on this topic, as well as with Captain Burton, shortly after their return, I endeavoured to combat this view, but being at that time in entire ignorance of the upper course of the White Nile, no solution could be found for what seemed to be then an insuperable difficulty.

* 'Journal,' vol. xxix., 1859, p. 234, &c.

† See Capt. Burton, in 'Journal,' vol. xxxv., 1865, p. 4.

That an inland sea, of such magnitude, receiving the drainage of such a great extent of country, in a climate where the evaporation bears a large proportion to the rainfall, it is quite incredible that its waters should be FRESH. In the countless ages since its formation, it must have become saline, like the Dead Sea, as an extreme case, or the Caspian as another, or the Shirwa Lake of Dr. Livingstone, the deep waters of which are brackish, and taste like a weak solution of Epsom salts. Every other known lake without an outlet is, I believe, of the same character, saline, and varying in its level.

If this be granted, as I presume must be done by every geographer, there are only three solutions to the problem. First, that it has an outlet to the Indian Ocean south of the route of the two East Africa expeditions; or, secondly, that some river runs to the westward, forming an affluent of the Congo, or other large Atlantic river; or, thirdly, that it drains northward, to which argument these remarks tend.

In the first place, its outlet cannot run towards the Indian Ocean, to the northward of the parallel of its southern end, for that region was perfectly explored by Burton, Speke, and Grant. The Lufigi River, which debouches in lat. $8^{\circ} 0'$ s., has not been examined, but its known character will not admit of such a supposition. Its upper course, known as the Ruaha, traverses the upland desert only in the rainy season, and the space between its occasional sources, and the south end of Tanganyika Lake, is constantly traversed by the Arab caravans passing from Zanzibar towards Lucenda, for ivory, and Kitanda, or Kitata, south of the Cazembe's, for copper. These cross or pass a shallow morass or lake, the Rukwa lagoon, which, at times, joins the Tanganyika Lake. No river is crossed. The Ruaha, whose real sources are still unknown, is not passed. It cannot then run eastward.

The second alternative is that it drains to the westward, or in other words, that it either contains the source of the Congo, whose mouth is 1100 miles from the western shore of the lake, or that the waters flowing westward are finally absorbed by evaporation. To combat these views with the facts at command would lead far beyond the limits of this paper. Suffice it to say, that several routes to the westward of the Tanganyika, not only negative this, but also would almost prove that the waters flow *into* the lake. The great distance will present now the most cogent argument against this, while we have the third, that the Rusizi River is an effluent.

The THIRD point I would insist on is this northern outlet of the lake.

The additional knowledge we now have places this matter in

a very different position to what it was in 1859, and accordingly I now aver that, if our late data be correct, there can be no other solution to the Nile question. I will name the difficulties as they have arisen.

After Burton and Speke had finished their exploration of Tanganyika, and become somewhat improved in health by their stay of nearly three months on the lake, they returned, with means almost exhausted, to Kazeh; and here Captain Speke quite recovered from his partial blindness, and from the effects of a small beetle which penetrated his ear, and suppurated away, completed the rough outline of their route, and forwarded it to England, with the map No. 1, which shows that they conceived that the Tanganyika continued to a valley open to the N.N.W. Captain Speke, leaving Burton to prepare for their return march, then started for the northern or Ukerewe Lake, July 9th, and on August 3rd observed it to be higher than Kazeh, or 3,740 feet. This, also, was an imperfect result, from the defective thermometer. Returning to Kazeh, they collected the remnant of their property, and retraced their steps to the coast.

After having visited the Ukerewe, or Victoria Nyanza, Captain Speke was firmly convinced that this was the true and *only* head of the Nile. That it is one of these reservoirs, no one can doubt. But in order to account for the supposed southern flow of the Ruzizi River, he drew the range of lofty mountains around the head of the lake, and between it and his own Lake Victoria, at a distance of 150 to 170 miles to the northward. These were purely hypothetical, as they were never seen or heard of. Their relation to the first map, sent after their return from Tanganyika, may be seen by reference to sketch No. 2, which is placed on the same parallel on the paper.

The second East Africa expedition, under Captains Speke and Grant, went over precisely the same ground that the first had done, except where crossing the lofty coast ranges. Arrived at the upper plateau, we find that the thermometric observations in the second expedition, as compared with the first, give a lower elevation of about 350 feet, to the country up to within 40 miles of Kazeh, their crucial station, but here the second elevations exceed the first by about 100 feet. It is probable, therefore, that hereabout the instruments in the first expedition began to fail.

It has been objected that these absolute and independent observations by the thermometer involve a fallacy, as the difference of level thus shown must be dependent on the varying pressure of the atmosphere: but to this may be replied that

this region is so near to the equator, that the diurnal or secular variations of the barometer are nearly at a minimum, and that the whole range, except during cyclones or hurricanes, does not exceed a very few tenths of an inch in the mercurial column (each tenth of an inch representing 85 feet of elevation); and that all the observations relating to this point were taken under the same circumstances. Most certainly absolute accuracy must not be demanded for them—at best they can be but approximations.

Captain Speke made the elevation of the north side of his Victoria Nyanza (in his second expedition), to be 432 feet lower than in the first; and between this point and Gondokoro he made FOUR other observations, to which I wish to draw especial attention. The first is near Kamrasi's Palace (Luluga), 2856 feet; the second at the Karuma Falls, 2970 feet; the third, South Luluga, between Karuma Falls and Kamrasi's, 2906 feet; and Paira, 18 miles south of the junction of the Asua River, 1793 feet. (Sir Samuel Baker says that the Nile, issuing from the Albert Nyanza, is navigable as far as this, and therefore they are on the same level.) Finally, Gondokoro was made to be 1298 feet above the sea. Captain Speke's thermometers, I believe, were not brought home, and therefore, their index errors, which were probably considerable, cannot now be ascertained. But they are all relative to each other, and one common correction would apply to all.

Captain Speke heard of the Great Lake, to the westward of Kamrasi's, since explored by Sir Samuel Baker and his lady, and named by him the Albert Nyanza. This lake was also reported to lie in almost the same position by Mr. Petherick, from information given to him by his man Mussaad, who went southward to within four days' march north-west of the north end of the lake. It was also announced by Dr. Peney, May 20th, 1861; he had then got beyond the cataracts of Makedo, and heard of it. His death prevented his exploring it. M. Debono was associated with him.

In addition to this lake, Captain Speke places another, the Rusizi Lake, at the distance of 110 miles due north of the north extremity of the Tanganyika Lake, and connects them by the Rusizi River, which passes through Uzige country. This Rusizi Lake, therefore, lies in the heart of the mountains he inferred to exist in 1858.

The names Ujiji, Rusizi, Uzige, and N'zige, which are placed on this line by Captain Speke, have a great resemblance to each other.

Mr. Consul Petherick reached Gondokoro February 20th,

1863, and made the elevation by thermometer B. P. (three observations) 1265 feet, a remarkable coincidence with those of Captain Speke's—they are identical.*

Mr. Petherick gave a similar thermometer to Sir Samuel Baker, who had arrived at Gondokoro a few days previously; and this also has been returned and tested,† so that its error, and the application of the difference, is not only available for its own results, but will also test and correct those which can be directly connected with it.

Sir Samuel Baker and his lady ascended the rivers on the track which had been descended by Captains Speke and Grant; and with this thermometer of Mr. Casella's he observed the altitude at the four places I have mentioned above as having been observed by Captain Speke. For the sake of comparison they are placed (with Gondokoro) in juxtaposition below; those of Captains Speke and Grant being uncorrected, and those of Sir Samuel Baker, with those final corrections determined on at Kew.

	SPEKE.			SIR S. BAKER.	Difference.
Luluga (Kamrasi's) ..	2856 ft.	Mrooli (do.) ..	..	4061 ft.	1205 ft.
Karuma Falls	2970	.. ..	..	3966	1026
S. Luluga	2906	.. ..	..	4056	1150
Paira	1793	(R. Nile, near)	..	2720	927
Gondokoro	1298	.. ..	..	1999	701

Mean of the five differences, 1002 ft.

We have thus a clear difference between Captain Speke and Sir Samuel Baker of 1000 feet, at nearly, or quite, the same places. This may seem to be a very large proportion of the entire elevations; but it should be remembered that even in the last one, Gondokoro, it has been thought necessary to add 700 feet to the result obtained by Mr. Petherick with the same instrument.

This difference of 1000 feet must therefore be either *subtracted* from Sir Samuel Baker's elevations or *added* to Captain Speke's; one or the other will prove the point I wish to insist on here.

Not only will this correction regulate the observations made in Captain Speke's second expedition, but it will apply to those made in the first, as the second passed over the same ground.

It has been said above that the second expedition made Kazeh 92 feet, as a mean higher than did the first. Therefore

* Mr. Petherick's observations are given in the 'Journal,' 1865, vol. xxxv., p. 300.

† See 'Journal,' 1866, vol. xxxvi., p. 16, where Sir S. Baker's observations are computed and investigated by Mr. Dunkin.

the observation at Tanganyika must also be brought in, as it was made by the same instrument, placing it at 1844 feet.

Now as Captain Speke's measurements throughout are consistent with each other, if we accept them as correct, it is perfectly possible for Tanganyika Lake at 1844 feet to flow into Gondokoro at 1298 feet, past Paira at 1793 feet elevation.

But then Sir Samuel Baker makes the Albert Nyanza to be elevated 2720 feet. If we take Captain Speke's observations as correct, this must be *reduced* to 1720 feet, identical with Captain Speke's observations at Paira, nearly or quite on the lake-level. Or, what is much more reasonable, we must apply the known correction by Sir Samuel Baker's thermometer to Captain Speke's observation, acknowledged to be imperfect; this will bring Tanganyika Lake up to 2844 feet, or **124 FEET ABOVE THE ALBERT NYANZA.**

Either of these views will quite determine the question as to the POSSIBILITY of Lake Tanganyika being connected with the Albert Nyanza.

Without claiming for these hypsometrical observations any refinement—they can be but simple approximations—and putting aside minor differences, it may be broadly stated that these two great western lakes *are on the same level.*

It is not necessary here to apply this reasoning to the stated elevation of the Victoria Nyanza, though of course it must fall into the same category, for no one can doubt but that the waters seen by Captain Speke to flow from the direction of its northern side finally enter the Nile.

Having disposed of the question of elevation, the next point is the geographical position of the lakes. This is most simply met.

Captain Speke heard, in 1861-2, of a lake, the Rusizi, due north of the Tanganyika Lake, and lying between latitudes 1° and 2° s., westward of the lofty Mfumbiro Peak.

Sir Samuel Baker sailed down the north-eastern side of the lake, past its abrupt cliffs of granite and gneiss, rising abruptly from the water to 1200 and 1500 feet high, and heard from King Kamrasi and many natives that it was well known as far as between latitudes 1° and 2° s., when it, turns to the westward, the extent being unknown even to Rumanika, king of Karagwé.

This enormous lake, thus at least 260 miles in length, embosomed in lofty mountains on either hand, extends to and covers the site of the Rusizi Lake, heard of by Captain Speke, and passes over his mountains of 1858.

Who, then, can doubt, if the data we possess be worth anything, but that *they are one and the same lake?*

I therefore claim for Lake Tanganyika, as I did in 1859, when I believe I stood alone, the honour of being the SOUTHERNMOST RESERVOIR OF THE NILE, until some more positive evidence, by actual observation, shall otherwise determine it.

The points, then, which I have endeavoured to prove are: that Dr. Livingstone, by determining the division of the water-flow to the westward of his Nyassa Lake, in September, 1863, had probably reached some of those occasional streamlets which feed the Nile.

That in his last journey, by continuing westward, he had determined that no *large* river entered the north end of the Nyassa Lake, and therefore determined the watershed between the Nile and Zambesi systems.

That all evidence acquired by the Portuguese travellers, read in the light brought to the subject by recent investigation, tends to the certainty of the truth of Burton and Speke's assertion, that the water *enters* the south end of Tanganyika Lake.

That Captain Speke's single observation as to the elevation of that lake is probably erroneous to the extent of the index error showed by his thermometer on the sea-shore, 2°, equal to about 1000 feet, and that otherwise, if Sir S. Baker's observations and information be correct, his Albert Nyanza would flow to the southward, the contrary of which he has proved.

The true sources of the Nile must be looked for in the mountains west and north-west of the Nyassa Lake, or in the great Serra Muchinga of the Portuguese travellers, between latitudes 11° and 12° s.; thus adding 600 miles to the known course of that wonderful river, to which each new discovery adds a new interest.*

The final solution of this most ancient and most interesting problem would indeed be a geographical triumph. I earnestly hope that it may be claimed soon by the Royal Geographical Society, which has done so much to clear away the dark clouds of mystery in which it was enshrouded ten years ago.

But there is another aspect in which the inquiry would place itself in a practical sense, and this to many may be considered of greater importance than the solution of an abstract geographical problem. To what good can such a discovery be applied? A few words will, I think, demonstrate this.

* The length of the Nile's course from Gondokoro to its mouth, following its major windings, is about 2400 geographic miles (or 2780 British miles). From Gondokoro, near to which, it was generally argued, ten years ago, that the southernmost head of the Nile would be found to the south end of Tanganyika Lake, is 830 geographic miles (or 960 British miles). If the source be near the Muxinga Range, it must be 270 geographic miles (or 312 British miles) still further south, so that its total course will be 3500 geographic, or 4050 British miles—almost unparalleled by any other river.

At present the commerce of the Upper Nile is transported by water as far as Gondokoro, and ceases a few miles above it.

If this branch of the Great Nile be navigable southward from the Makedo or Apuddo Cataracts, down the Albert Lake to its southern end, a distance of 400 miles, and if the Rusizi River be a continuation of it, at the same level, as at present appears, it may extend this navigable part of the Upper Nile for 340 miles further, to the head of the Tanganyika Lake, and to within a few miles of the great African capital of the Cazembe, one of the chief ivory marts, and also near to Kitanga or Kitata, the copper mart.

We should have thus an additional 750 or 800 miles of water-carriage for that commerce which ought to be the best pioneer of civilisation in these otherwise unapproachable regions. A few vessels of shallow draught, impelled by steam or sail, would intercept the whole of the traffic which is now carried on with the greatest vigour between the vast and entirely unknown west, and the infamous slave-depôts on the shores of the Indian Ocean.

As is well known, the chief article of the export trade, ivory, would be nearly worthless in the interior without selling as a slave the porter who brings it to the coast. By diverting this double traffic to the northward, to the Egyptian posts at Gondokoro or elsewhere, we, as a nation, could have very much more influence in repressing the trade in the human portion of it than is now possible at the well-known ports of Mombas, Ibo, Quiloa, and many other notorious places.

If by further exploration it could be determined that such a line of navigation is practicable, and which would be transverse to that now carried on, commercial enterprise, in some form, might soon be established there. This would cut off the slave trade from between the western countries and the coast.

XI.—*Notes on the Russian Harbours on the Coast of Manchuria.*

By Rev. W. V. LLOYD, R.N., F.R.G.S.

(Read, June 24, 1867.)

ON the 20th of July, 1866, H.M.S. *Seylla*, Captain Courtenay, left Nagasaki, Japan, with orders to visit the different Russian settlements on the east coast of Manchuria, from the southern boundary of their late acquisition of Chinese territory, the "Tu-men" River, to Castries Bay, along the west coast of Sakhalin to the seemingly unsettled boundary (on the 48° parallel of latitude) between them and the Japanese: also the ports of the